CLAIMS

1. A method for manufacturing a monocrystalline thin film, comprising the steps of;

(a) preparing a monocrystalline substrate;

(b) forming a sacrificial layer containing crystal defects on the monocrystalline substrate using the same material by epitaxial growth;

(c) forming a monocrystalline thin film containing crystal defects on the sacrificial layer using the same material by epitaxial growth, the number of the crystal defects being smaller than that of the sacrificial layer; and

(d) etching the sacrificial layer so as to form a monocrystalline thin film containing a small number of crystal defects.

2. The method for manufacturing a monocrystalline thin film, according to Claim 1, further comprising the step of eliminating crystal defects present on the surface of the sacrificial layer following the step (b).

3. The method for manufacturing a monocrystalline thin film, according to Claim 1 or 2, wherein the monocrystalline substrate is a monocrystalline silicon substrate, the

sacrificial layer is a silicon sacrificial layer, and the monocrystalline thin film is a monocrystalline silicon thin film.

4. The method for manufacturing a monocrystalline thin film, according to Claim 1 or 2, wherein the monocrystalline substrate is a monocrystalline GaAs substrate.

5. The method for manufacturing a monocrystalline thin film, according to Claim 1 or 2, wherein the monocrystalline substrate is a monocrystalline MgO substrate.

6. The method for manufacturing a monocrystalline thin film, according to Claim 1, wherein the step (b) is performed by a physical vapor deposition method or a chemical vapor deposition method at a temperature of 400 to 1,200°C, whereby a silicon sacrificial layer containing crystal defects is epitaxially-grown.

7. The method for manufacturing a monocrystalline thin film, according to Claims 3 or 6, wherein the crystal defects include twins, vacancies, interstitial atoms, edge displacements , and screw displacements.

8. The method for manufacturing a monocrystalline thin

film, according to one of Claims 3, 6, and 7, wherein the number density of the crystal defects is $1/\mu m^2$ to $1/nm^2$ at the boundary between the monocrystalline silicon substrate and the silicon sacrificial layer.

9. The method for manufacturing a monocrystalline thin film, according to one of Claims 3 and 6 to 8, wherein twins exist at the boundary between the monocrystalline silicon substrate and the silicon sacrificial layer at a number density of $1/\mu m^2$ to $1/nm^2$.

10. The method for manufacturing a monocrystalline thin film, according to one of Claims 3 and 6 to 9, further comprising, following the step (b), the step of performing thermal annealing in a reducing atmosphere at a temperature of 1,000 to 1,400°C to eliminate crystal defects on the surface of the silicon sacrificial layer.

11. The method for manufacturing a monocrystalline thin film, according to Claim 10, wherein after the thermal annealing, the number density of twins present on the surface of the silicon sacrificial layer is one hundredth or less of that of twins present at the boundary between the monocrystalline silicon substrate and the silicon sacrificial layer.

12. The method for manufacturing a monocrystalline thin film, according to one of Claims 3 and 6 to 11, wherein the step (c) is performed by a physical vapor deposition method or a chemical vapor deposition method at a temperature of 1,000 to 1,400°C, whereby the monocrystalline silicon thin film containing a small number of crystal defects is formed by epitaxial growth.

13. The method for manufacturing a monocrystalline thin film, according to one of Claims 3 and 6 to 12, further comprising, following the step (c), the steps of: supporting the monocrystalline silicon thin film by a support base material, and then etching the silicon sacrificial layer so as to manufacture the monocrystalline silicon thin film.

14. The method for manufacturing a monocrystalline thin film, according to one of Claims 3 and 6 to 13, further comprising the step of forming holes in the monocrystalline silicon substrate at intervals.

15. The method for manufacturing a monocrystalline thin film, according to one of Claims 3 and 6 to 14, wherein the thickness of the silicon sacrificial layer is set to 100 nm or less so that roughness of the bottom surface of the

monocrystalline silicon thin film is reduced to 100 nm or less.

16. The method for manufacturing a monocrystalline thin film, according to one of Claims 3 and 6 to 14, wherein the thickness of the silicon sacrificial layer is set to 100 nm or more so that the bottom surface of the monocrystalline silicon thin film has a texture structure of 100 nm or more.

17. The method for manufacturing a monocrystalline thin film, according to one of Claims 3 and 6 to 16, further comprising the step of forming a texture structure on the surface of the monocrystalline silicon substrate.

18. The method for manufacturing a monocrystalline thin film, according to one of Claims 3 and 6 to 17, wherein the etching of the silicon sacrificial layer is performed using a mixed solution of hydrofluoric acid and an oxidizing agent.

19. A monocrystalline thin film device obtained by the method for manufacturing a monocrystalline thin film, according to one of Claims 1 to 5.

20. A monocrystalline thin film device obtained by the method for manufacturing a monocrystalline silicon thin film,

according to one of Claims 3 and 6 to 18.

21. The monocrystalline thin film device according to Claim 20, wherein the monocrystalline silicon thin film is a photovoltaic layer of solar-cells.

22. The monocrystalline thin film device according to Claim 20, wherein the monocrystalline silicon thin film is a monocrystalline silicon thin film used for SOI.

23. A method for manufacturing a solar-cell monocrystalline silicon thin film, comprising the steps of;

(a) preparing a monocrystalline silicon substrate;

(b) forming an epitaxial sacrificial layer on the substrate;

(c) rapidly forming a monocrystalline silicon thin film on the sacrificial layer by epitaxial growth; and

(d) etching the sacrificial layer so as to manufacture a monocrystalline silicon thin film used as a photovoltaic layer for solar-cells.

24. The method for manufacturing a solar-cell monocrystalline silicon thin film, according to Claim 23, wherein the monocrystalline silicon thin film is formed by epitaxial growth at a temperature T(°C) and at a film growth

rate GR (μm/min) which satisfies the condition of $GR>2\times10^{12}\exp[-325(kJ/mol)/8.31(J/mol\cdot K)/(T+273)(K)]$, whereby the change in structure of the sacrificial layer is prevented.

25. The method for manufacturing a solar-cell monocrystalline silicon thin film, according to Claim 23 or 24, wherein the rapid epitaxial growth of the monocrystalline silicon thin film is performed by a physical vapor deposition.

26. The method for manufacturing a solar-cell monocrystalline silicon thin film, according to one of Claims 23 to 25, wherein the sacrificial layer is crystal silicon containing crystal defects.

27. The method for manufacturing a solar-cell monocrystalline silicon thin film, according to Claim 26, wherein the crystal defects includes twins, vacancies, interstitial atoms, edge displacements, and screw displacements.

28. The method for manufacturing a solar-cell monocrystalline silicon thin film, according to Claim 26 or 27, wherein the number density of the crystal defects is

$1/\mu m^2$ to $1/nm^2$ at the boundary between the monocrystalline silicon substrate and the silicon sacrificial layer.

29. The method for manufacturing a solar-cell monocrystalline silicon thin film, according to one of Claims 25 to 28, further comprising the step of eliminating crystal defects present on the surface of the sacrificial layer following the step (b).

30. The method for manufacturing a solar-cell monocrystalline silicon thin film, according to one of Claims 23 to 25, wherein the sacrificial layer is highly doped monocrystalline silicon.

31. The method for manufacturing a solar-cell monocrystalline silicon thin film, according to Claim 30, wherein a dopant doped in the highly doped monocrystalline silicon is an element of group III or V.

32. The method for manufacturing a solar-cell monocrystalline silicon thin film, according to Claim 30 or 31, wherein the dopant concentration of the highly doped monocrystalline silicon is 10^{18} atoms/cm^3 or more.

33. The method for manufacturing a solar-cell

monocrystalline silicon thin film, according to one of Claims 30 to 32, wherein a dopant source is supplied onto the surface of the monocrystalline silicon substrate, whereby the highly doped monocrystalline silicon sacrificial layer is formed.

34. The method for manufacturing a solar-cell monocrystalline silicon thin film, according to one of Claims 30 to 32, wherein a silicon source and a dopant source are simultaneously supplied onto the monocrystalline silicon substrate, whereby the highly doped monocrystalline silicon sacrificial layer is formed.

35. The method for manufacturing a solar-cell monocrystalline silicon thin film, according to one of Claims 30 to 32, wherein a silicon source and a dopant source are supplied onto the monocrystalline silicon substrate while the ratio between the two sources is controlled with time so as to form a highly doped layer and a lightly doped layer in a silicon film which is rapidly epitaxially-grown, and the former is used as the sacrificial layer and the latter is used as the monocrystalline silicon thin film for a photovoltaic layer of solar cells.

36. The method for manufacturing a solar-cell

monocrystalline silicon thin film, according to one of Claims 23 to 25, wherein the sacrificial layer comprises compound crystal containing silicon.

37. The method for manufacturing a solar-cell monocrystalline silicon thin film, according to Claim 36, wherein the compound crystal containing silicon is a metal silicide including $CoSi_2$, $NiSi_2$, or $CrSi_2$.

38. The method for manufacturing a solar-cell monocrystalline silicon thin film, according to one of Claims 23 to 25, wherein the sacrificial layer comprises crystal containing no silicon.

39. The method for manufacturing a solar-cell monocrystalline silicon thin film, according to one of Claims 23 to 38, wherein the sacrificial layer is etched using an aqueous solution containing hydrofluoric acid, whereby the monocrystalline silicon thin film used as a photovoltaic layer of solar cells is manufactured.

40. The method for manufacturing a solar-cell monocrystalline silicon thin film, according to one of Claims 23 to 39, further comprising, following the step (c), the steps of: supporting the monocrystalline silicon thin

film used as a photovoltaic layer of solar cells by a support base material, and then etching the silicon sacrificial layer, whereby the monocrystalline silicon thin film used as a photovoltaic layer of solar cells is manufactured.

41. The method for manufacturing a solar-cell monocrystalline silicon thin film, according to one of Claims 23 to 40, further comprising the step of forming holes in the monocrystalline silicon substrate at intervals.

42. The method for manufacturing a solar-cell monocrystalline silicon thin film, according to one of Claims 23 to 41, further comprising the step of forming a texture structure on the surface of the monocrystalline silicon substrate.

43. A monocrystalline silicon thin film solar cell obtained by the method for manufacturing a solar-cell monocrystalline silicon thin film according to one of Claims 23 to 42.